

CHRONIC
SUPPURATIVE OTITIS MEDIA & ITS
CONSEQUENCES
WITH
AN ACCOUNT OF THE
ANATOMY OF THE TEMPORAL BONE.

BY

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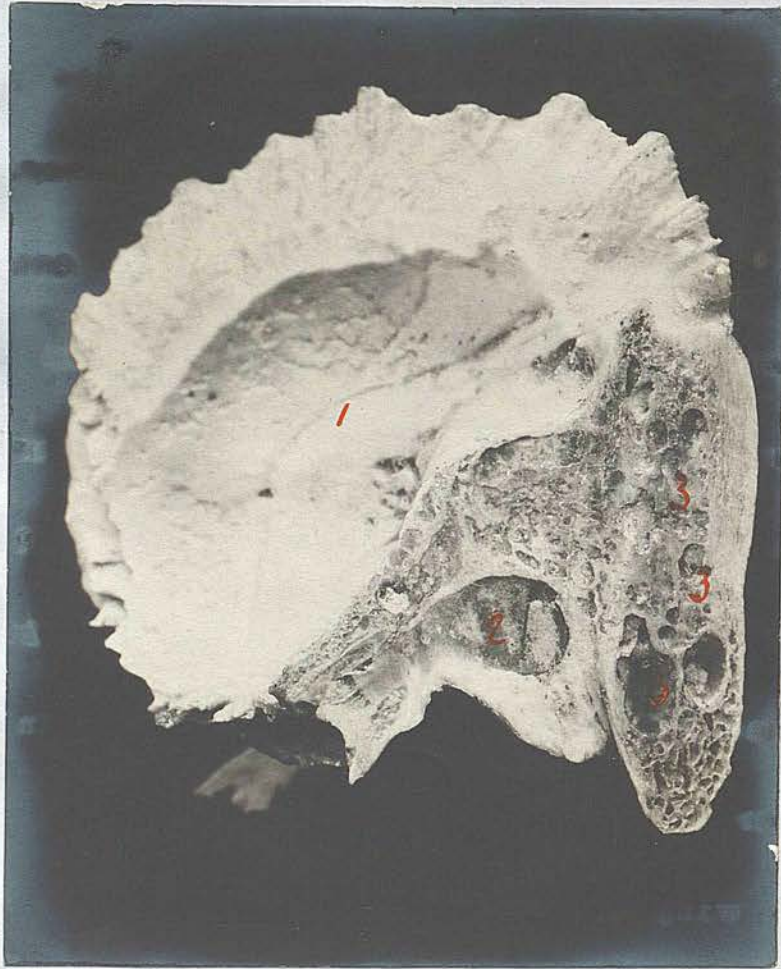
I L L U S T R A T I O N S.

1. External surface of temporal bone.
2. Internal surface
3. Inferior surface
4. Superior surface
5. Posterior surface
6. Sigmoid groove.
7. Jugular buttress.
8. Inferior Surface
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10. Petrous bone with tegmen removed.
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22. Aqueduct of Fallopius.
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24. Cases of subperiosteal abscess.

I N T R O D U C T I - O N .

The temporal from its surgical aspect is one of the most important bones in the human body & is the most complicated bone in the skull, containing as it does the delicate organ of hearing & that concerned in equilibration, forming a channel for the passage of important nerves & blood vessels & providing a bed for the great sigmoid sinus. Nor does its important relations end here for above & behind it is clothed by the membranes of the brain, is in contact with certain parts of the brain & cerebellum, while below it gives attachment to various important muscles & the pharynx & by its connection with the occipital bone, it gives protection to the great venous channel extending from the cranium to the neck & to those nervous trunks which are connected with the vital & organic functions of life. There is no bone in the human frame, which is at once so strong & at the same time so weak, no bone in

relation to such a wealth of blood & yet so poorly supplied with it, no bone so much protected from injury & yet so much exposed to disease & whose injury or disease leads to such vital consequences to the mental & physical life of the possessor. From disease of this bone the patient may suffer psychical blindness, word-deafness, motor aphasia, paralysis of limb & death. Its perfect health contributes to easy intercourse & agreeable companionship, while its disease may surround the possessor with a malodour, which forbids the advances of the most courageous & benevolent. The health of this bone is essential to that symmetry of form & proportion of the face which is normal & pleasing to the onlooker, while its disease may produce such disfigurement as to embarrass its possessor in his relations through life & interfere with the perfect nutrition of his body.



Inner surface of Squamous Bone.

1. Groove for Meningeal Artery.

Petio-mastoid in Section.

2. & 3. Tympanum & spaces injected with wax.

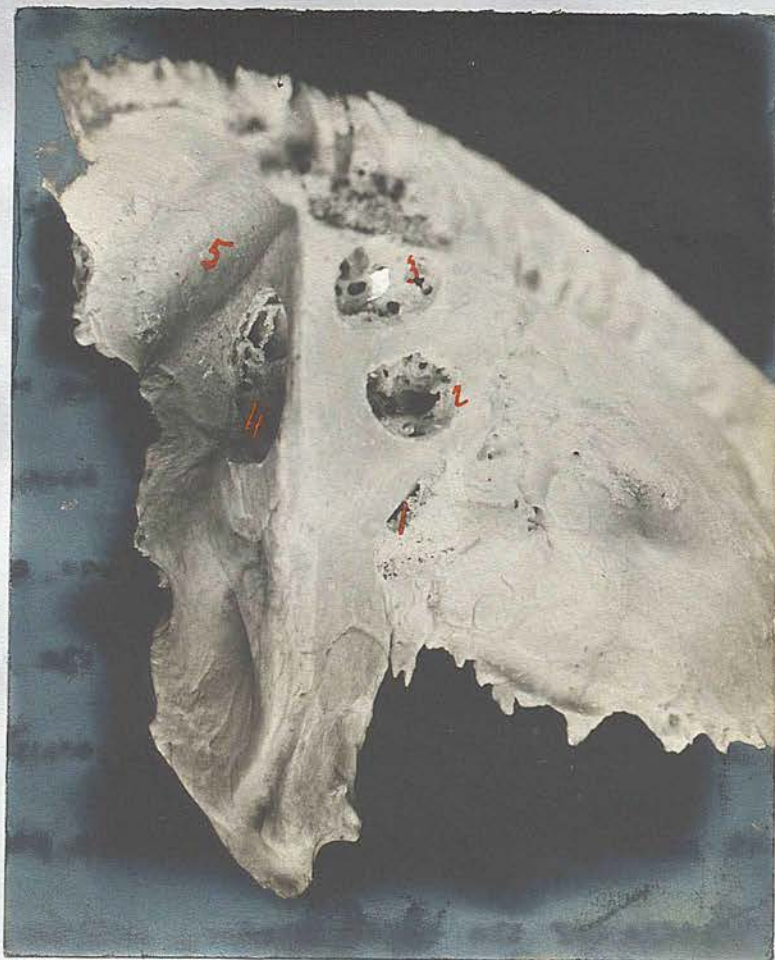
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below the posterior root of the zygoma is a depression, in front of which & encroaching upon it, is a small triangular area called the suprameatal ^{triangle} of Macewen.

The internal surface is slightly concave, marked by depressions for the convolutions of the brain & by a deep sinuous groove for the posterior branch of the middle meningeal artery. At its lower border as it sweeps inwards towards petromastoid it terminates abruptly at the petrosquamous suture. Posteriorly this suture becomes obliterated by fusion of the squamous & petromastoid portions, but anteriorly can always be seen, though more apparent in some bones than in others. The upper border is beveled¹ & overlaps the parietal & great wing of the sphenoid above, while, below this, & extending round to the base, the articulating surface is broad, rough & irregular & abuts directly on the adjacent portion of the great wing of the sphenoid. The under surface of this port-

Petro-mastoid seen from above and showing -

1. Tympanum opened
2. Antrum -
3. accessory Antrum.
4. Antrum from Posterior Surface internal to
- 5 the Groove.



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ion of the bone is carried into a deep depression, completed posteriorly by the tympanic bone & forms the glenoid fossa. This fossa is divided into a larger anterior & smaller posterior portion by the fissure of GLASER, near the inner end of which is a foramen, the opening of the canal of HUGIER, which transmits the chorda tympani nerve. The squamous portion of the bone is little marked either on the external or internal surface by foramina for nutrient vessels, is composed of little vascular compact bone & is very thin.

The petromastoid portion is pyramidal in shape & is wedged into the base of the skull between the occipital behind & the squamous portion in front. It is placed obliquely in the base, running forwards & inwards. It presents three surfaces, three borders, an apex & a base. The anterior surface is smooth & undulating, is composed of compact bone & presents a well marked eminence near the middle of the upper border, indicating

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the position of the ^{Superior} semicircular canal. Near the apex is a depression on which lies the Gasserian ganglion & between these two points & anterior to a line drawn between them is a shallow groove which leads into the Hiatus Fallopii, which transmits the great superficial petrosal nerve. The remainder of this surface as it extends downwards & forwards is marked by depressions, on which lie the convolutions of the brain. The anterior half of this surface is especially important from the fact that it is composed of a thin plate of bone which constitutes the tegmen or roof of the osseous portion of the Eustachian canal, the middle ear & the accessory spaces in the bone of which we shall have more to say later. This surface of the bone terminates at the petro-squamous suture which also marks the limit on this side of the tegmen.

The posterior surface looks backwards & inwards & the plane of it is nearly vertical. Near



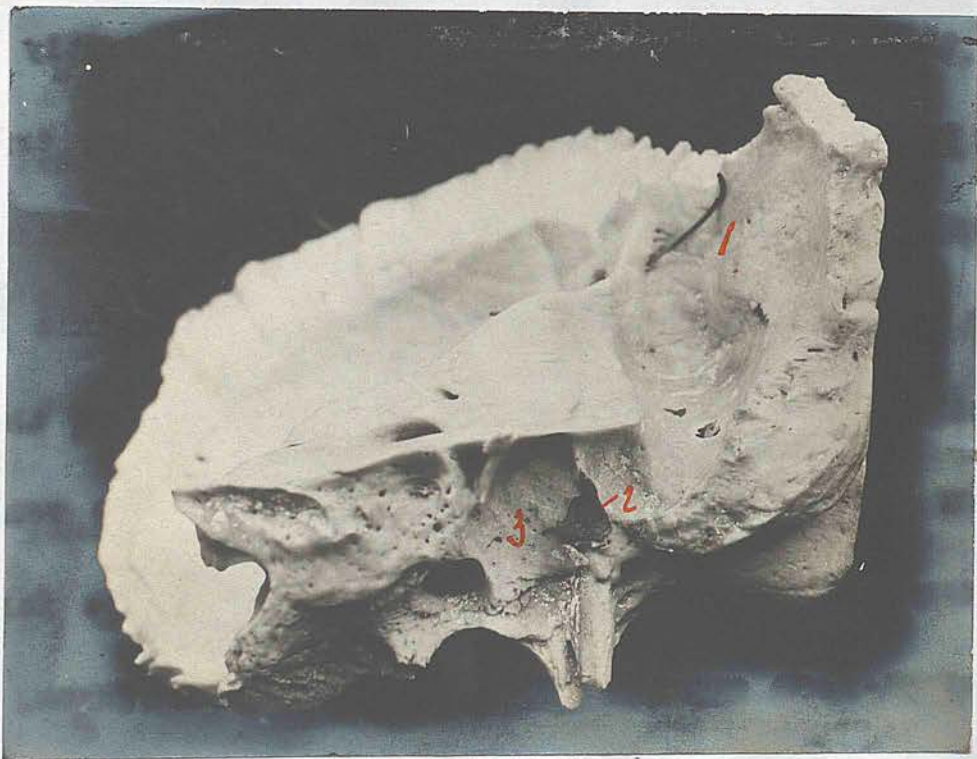
Petro mastoid seen from behind and showing
1. Sigmoid Groove.

the apex is a groove leading outwards to the internal auditory meatus which transmits the auditory & facial nerves. At the bottom of the meatus is a lower portion the cribriform lamina for the various branches of the auditory nerve & above this is the opening of the Aqueductus Fallopii for the facial nerve. External to the meatus is a depression, which in the fœtus is a foramen, the subarcuate foramen, for the subarcuate vein, a small vein passing from the sphenoparietal sinus to the sigmoid.

Below this is a fissure, overlapped by a scale of bone, which lodges the saccus endolymphaticus & makes a connection between the vestibule & the surface of the bone at this point. External to this region, the surface of the bone may be flat, concave or convex & closes in the antrum posteriorly. Beyond this surface is a deep, wide groove which lodges the sigmoid sinus & is called the sigmoid groove. This groove is directed with

Petrous Mastoid from below & behind showing -

1. Sigmoid Groove with Bristle from accessory Antium through vein canal.
2. Jugular Butress.
3. Jugular Fossa.



a bold double curve downwards over the base of the posterior surface of the petrous bone. It is ^{marked} with numerous small foramina, which carry small veins from the interior of the bone to the sigmoid sinus. Above, this groove is continued on to the posterior inferior angle of the parietal bone, & below it sweeps forwards with a curve to end in the jugular fossa. At its lowest point this groove is below the level of the entrance to the jugular fossa & between the lowest point & the fossa is a triangular ridge of bone formed partly by the petrous portion of the temporal & partly by the jugular process of the occipital. This triangular ridge plays an important part in directing the blood stream & with other factors prevents aspiratory action extending to the interior of the cranium. The inferior surface of the bone is rough & irregular & presents from apex to base the following:- the carotid foramen, the jugular fossa, the surface for articulation with the jugular pro-

cess of the occipital, the styloid process, the stylo-mastoid foramen which is the termination of the Aqueductus Fallopii. On the surface of the jugular fossa is the opening of the canal for Jacobson's nerve, the tympanic branch of the glosso-pharyngeal. The greater part of this surface of the bone is marked with numerous small openings for the transmission of small vessels into & out of the interior of the bone & by rough areas for attachment of muscles.

Borders. The superior border separates the anterior & posterior surfaces, runs backwards & outwards & is marked by a groove for the superior petrosal sinus. It is the longest border & extends from the apex to the posterior end of the squamous bone. The anterior border is rough for the sphenoid & presents at its outer end the opening of the Eustachian canal. The canal is divided into an upper & lower compartment by the processus cochleariformis. The posterior border is marked by

the groove for the inferior petrosal sinus in its inner half & in the outer half is carried into a narrow ridge of bone which overlaps the jugular fossa & the lower end of the sigmoid groove. The apex is perforated by the end of the carotid canal & the canal itself presents the openings of many small vascular channels for the supply of blood to the tympanum. The base of the pyramid is formed by the mastoid behind & by the external auditory meatus in front. The mastoid process consists of two parts, the anterior, smooth & compact is formed by the descending plate of the squamous portion of the bone, the posterior part is rough, irregular & porous, perforated by numerous small foramina for vessels & by one larger than the rest but of variable size, the mastoid foramen which transmits a vein from the lateral or sigmoid sinus to join the occipital vein. The external auditory meatus is formed by the tympanic bone in front below & behind but above it is completed by the squamous

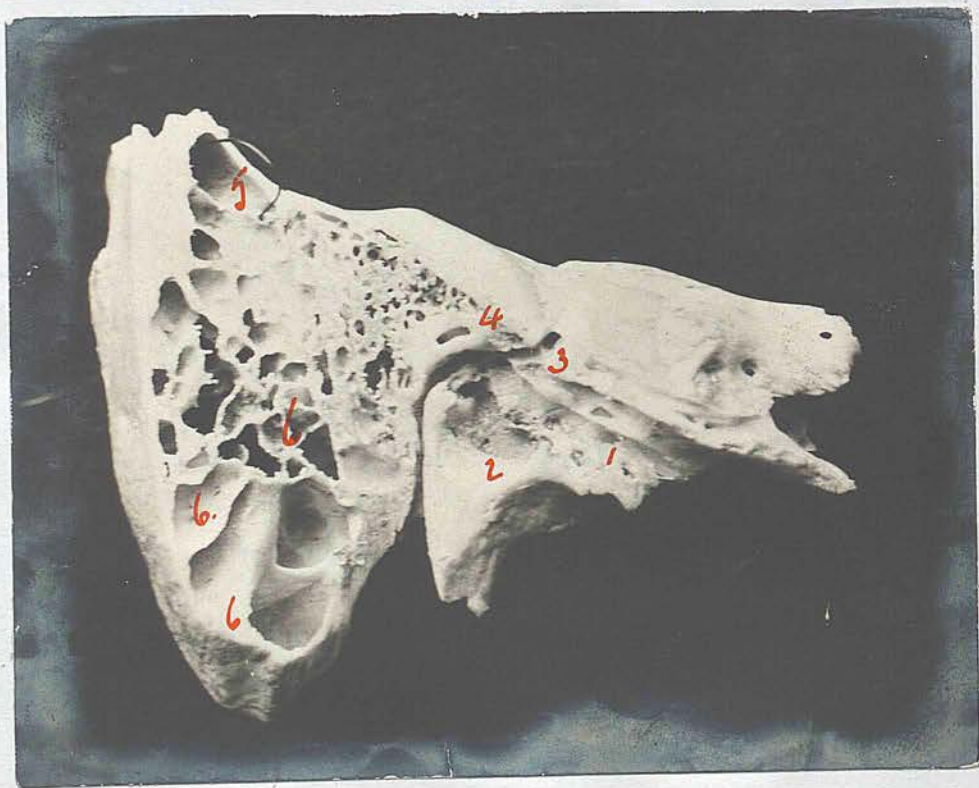
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portion of the bone.

Having thus briefly alluded to a few points to be noted on the surface of the temporal bone, we pass to the consideration of the interior of the bone. Between the two portions of the bone namely the squamous & the petromastoid, is a cleft like space in which are lodged the middle ear with its chain of ossicles, muscles & those accessory pneumatic spaces, which play such an important part in the pathology of this bone. The parts now to be considered are the tympanum, with its attic, the Eustachian canal, the antrum & the accessory antrum.

The Eustachian canal is about half an inch in length & $1/16$ in. in diameter, being slightly narrower at its anterior than at its posterior end. Its direction is backwards, upwards & outwards with a slight curve the convexity of which is upwards. At its tympanic end it becomes di-

Section of the Petro-mastoid showing -

1. Eustachian Canal.
2. Tympanum.
3. Aqueduct of Fallopius.
4. Horizontal semi-circular canal.
5. Accessory Antrum with bristle passing to Sigmoid Groove.
6. Spaces of the mastoid



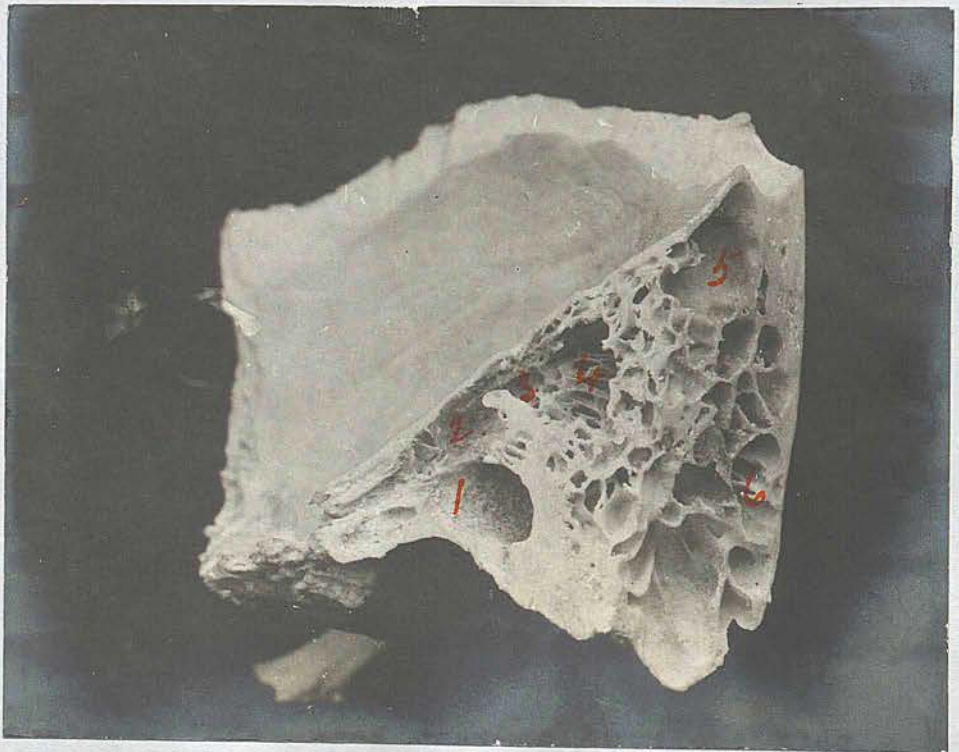
lated, the upper wall, formed by the processus cochleariformis, sloping upwards & forming the forepart of the roof of the tympanum. At its opening into the tympanic cavity the canal is at least $1/8$ in. (usually more) above the floor of the tympanum. The canal is smoothe, founded & perforated by numerous apertures for small vessels & is separated from the carotid canal by a thin plate of translucent bone. Above the canal is the tensor tympani muscle, but separated from it by the processus cochleariformis. This partition & muscle being interposed between the canal & the floor of the middle fossa of the skull.

The tympanic cavity is circular seen from without & compressed laterally & about $3/8$ in. or less, in its antero-posterior & vertical diameters, while laterally it is about one ^{fourth} of an inch. It presents for consideration an outer & an inner wall, a floor, a roof & anterior & posterior boundaries. The outer wall is formed by the mem-

brana tympani. The inner wall is irregular & marked a little above the middle by the promontory, a rounded eminence which marks the first turn of the cochlea, above this is the fenestra ovalis & below is the fenestra rotunda. Below this fenestra the inner wall is thin & in many bones is translucent & forms a partition between the tympanum & the jugular fossa; a fact of some importance in presence of a sharp spoon or gouge. The anterior wall slopes upwards & passes into the Eustachian canal. The posterior wall sweeps upwards from the curving, dense, concave floor & near its upper end bounds the opening into the antrum, i.e. the antro-tympanal passage. Internal to the antro-tympanal passage & forming its inner boundary is the aqueduct of Fallopius & between the aqueduct & the promontory is the pyramid, which lodges the stapedius muscle & its nerve. Above & behind the aqueduct is a dense prominence of bone which marks the position of the horizontal semi-

Section of Temporal Bone Showing -

- 1. Tympanum.*
- 2. Attic.*
- 3. Antro-Tympanic Passage.*
- 4. Antrum.*
- 5. Accessory Antrum.*
- 6. Spaces of Mastoid.*



circular canal. The outer wall of the antro-tympanal passage is formed of spongy bone containing no important structure. Above the limit of the outer wall of the tympanum the cavity is prolonged upwards for about $3/16$ in. forming the attic, which in health contains the upper ends of the incus & malleus. Its outer wall may be vertical & dense or it may be composed of cancellous tissue which slopes outwards as far as the petro-squamous suture very greatly increasing the size of the attic & forming a ready means of extension of infective processes to the interior of the cranium. The inner wall of the attic is formed by the aqueduct of Fallopius & the adjacent parts of the canal for the tensor tympani. It will be convenient to defer the consideration of the roof until later when its important relations will be more apparent.

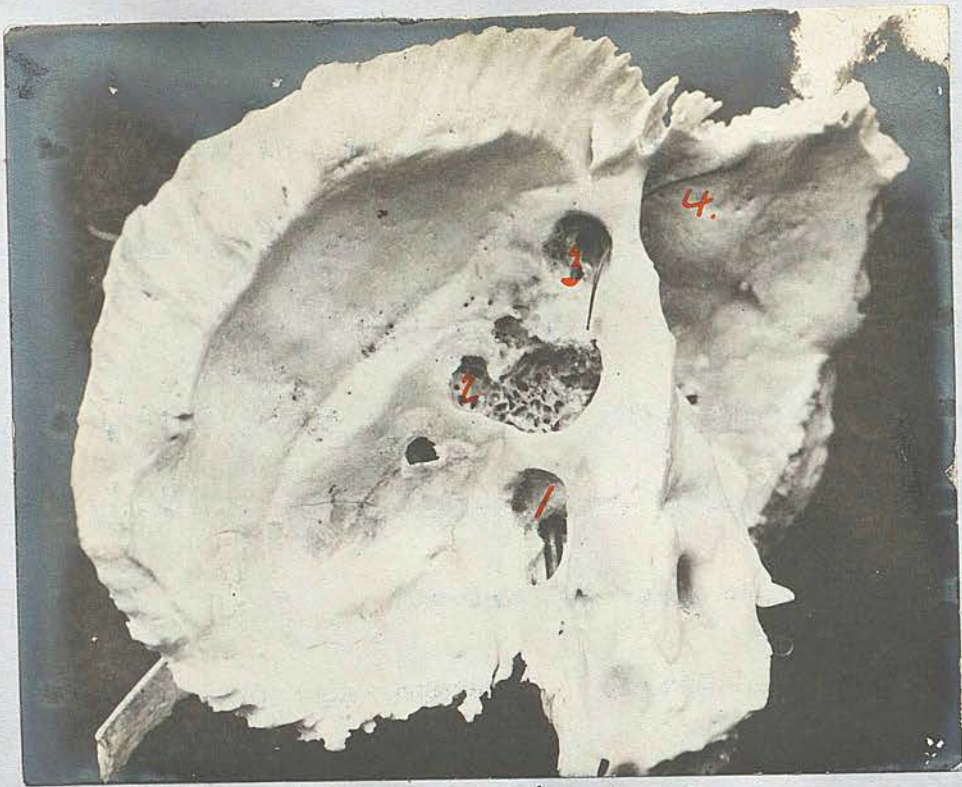
Antrum. The petromastoid portion of the temporal bone behind the middle ear is composed of a thin shell of compact bone, the interior



Section of the Petro-mastoid showing —

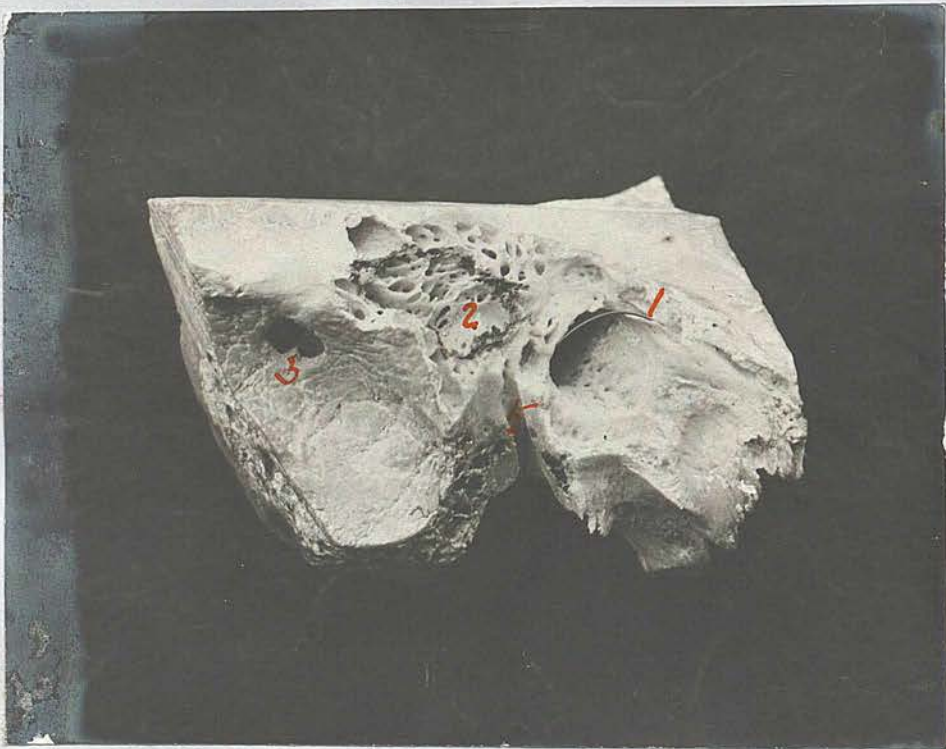
- 1. Antrium*
- 2. Horizontal semi-circular canal & Vestibule*
- 3. Aqueduct of Fallopius*

consisting of open more or less spongy bone. In the mastoid the sponge-work is open & the trabeculae strong, while in front of this & internal to it the mesh-work is close & the trabeculae fine. Behind the tympanum & above it is a space of variable size, surrounded by spongy bone & known as the antrum of the temporal bone, mastoid antrum or pneumatic sinus. It is irregular in shape & variable in size, but usually larger than the tympanic cavity & is situated above & behind the tympanum with which it communicates by a narrow opening-the antro-tympanic passage. This passage is above the level of the floor of both the tympanic cavity & the antrum. The walls of the antrum, except the roof, are composed of spongy bone in the healthy state, but in disease may be formed of dense sclerosed bone. As already stated in front it communicates with the tympanic cavity, behind it is separated from the posterior fossa by a comparatively thin plate of bone. The



Upper surface of Petro-mastoid showing —

Segmen removed (1) Tympanum (2) Antrum. (3) Accessory Antrum a Bristle passing to
(4) Sigmoid Groove.



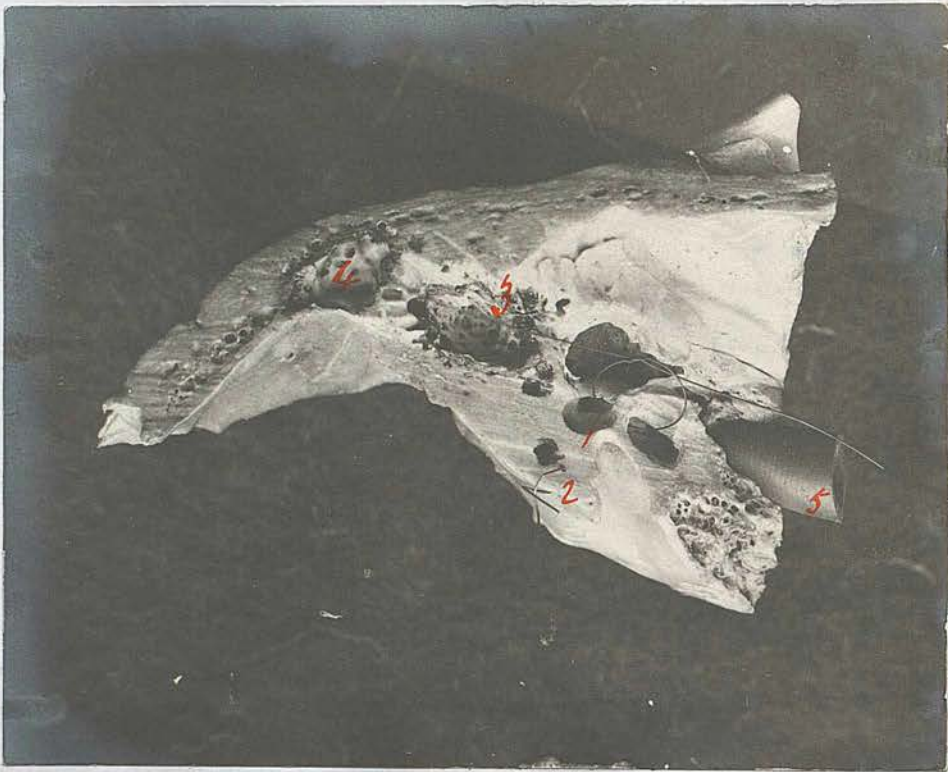
Section of Petro-mastoid. Showing —

1. Bristle for Chorda Tympani.
2. Antrum.
3. Accessory Antrum opened from Sigmoid Groove.
4. Aqueduct of Fallopian.

floor, internal & external surfaces are formed of spongy bone. The roof we will consider later.

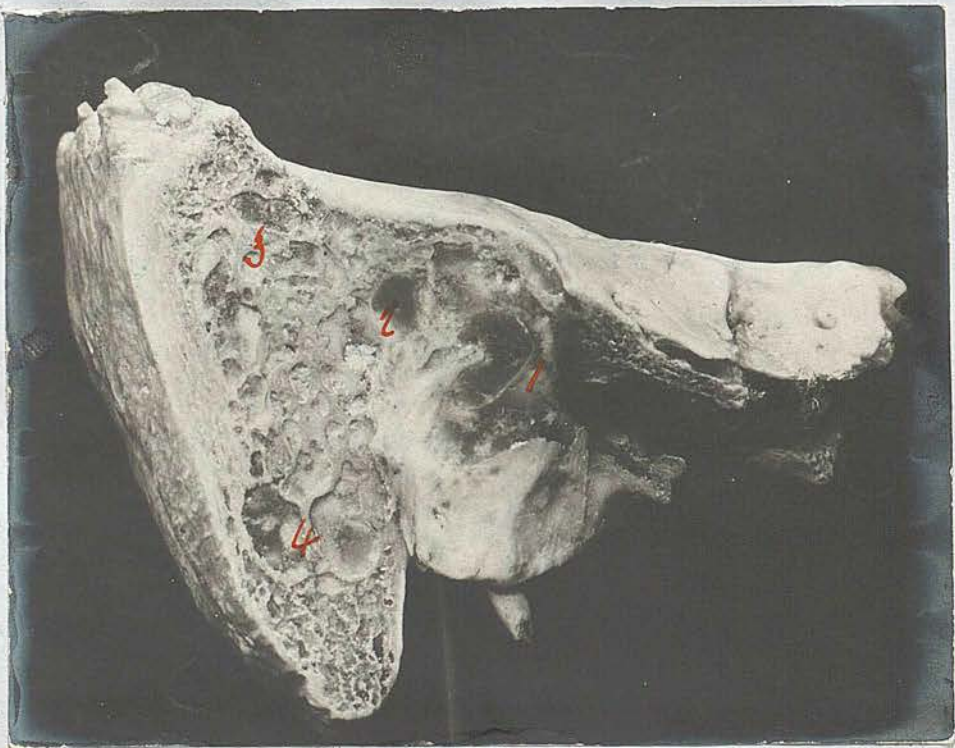
External & posterior to the antrum spread the spaces of the mastoid, variable in size, shape & arrangement but all intercommunicating, but not present at birth like the antrum.

Accessory Antrum. Amongst the many spaces in the mastoid region there is one which is always present, & though variable in size & position is constant. On account of the constancy of this space & the important relations it bears to the sigmoid groove, sinus & diploe I have ventured to name it the accessory antrum. It is situated under cover of the outer end of the superior border of the petrous bone & is therefore external & superior to the antrum proper. It communicates with the antrum by spaces & channels & with the mastoid cells & when large with the diploic space. Nor does its relations end here. It has the most intimate relation with the sigmoid groove,



Petro-mastoid seen from above showing —

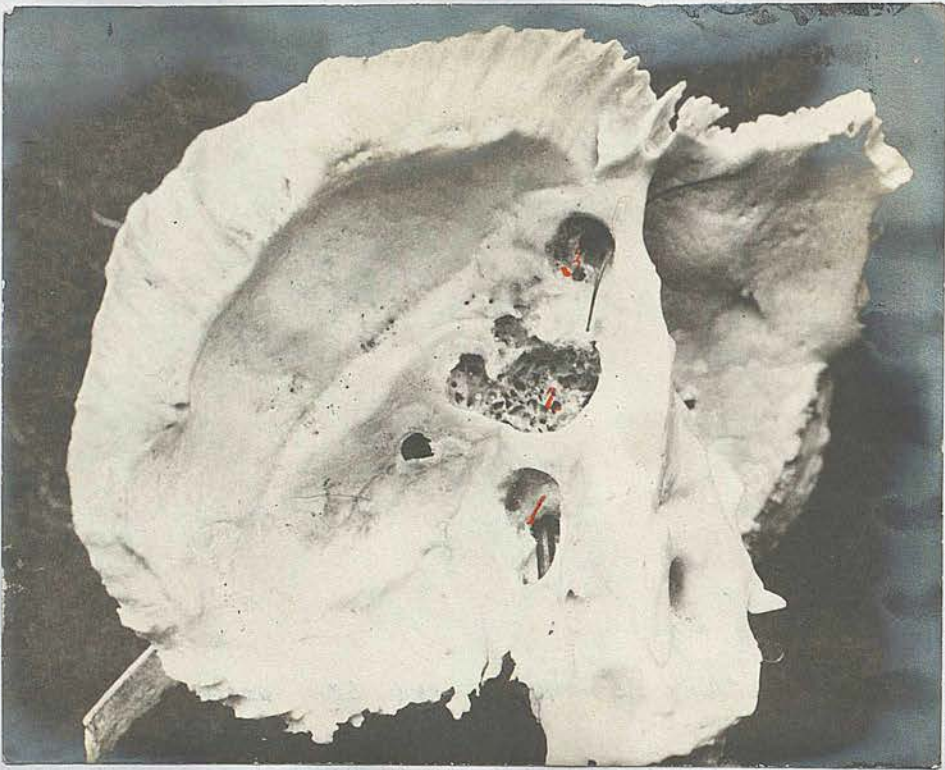
- (1) Vestibule. 2 Wire in Aqueductus Vestibuli. 3 Antrum. 4 Accessory Antrum.
5. Internal Carotid Artery.*



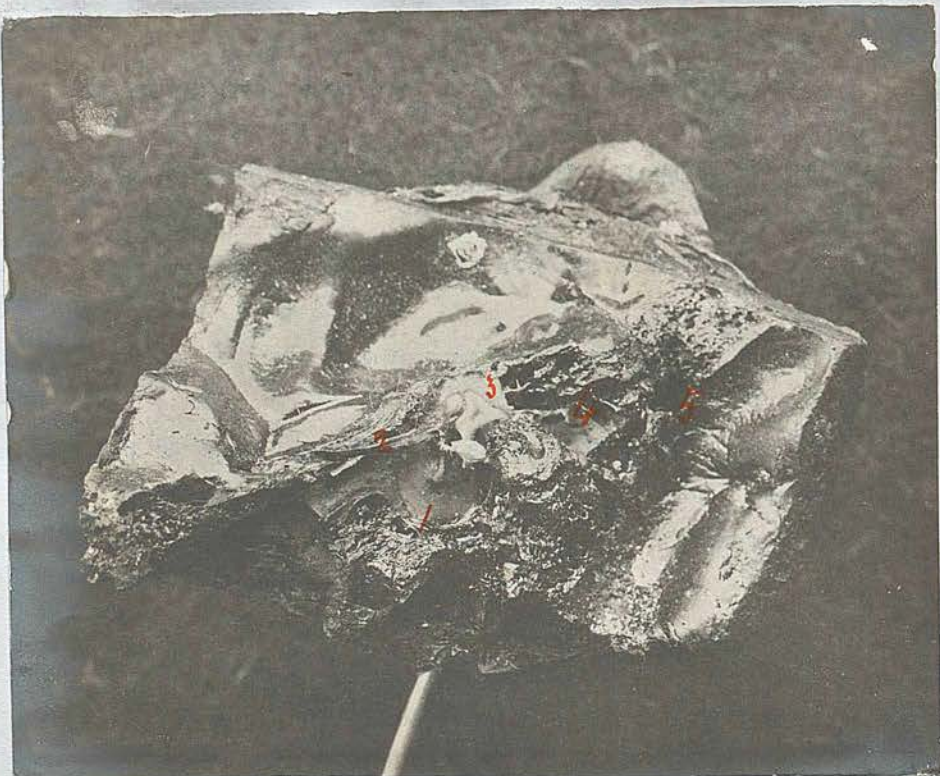
Section of Petro-mastoid injected with Hot. Wax

- 1. Tympanum. 2. Antrum. 3. Accessory Antrum. 4. Spaces of Mastoid.*

being separated from it ^{by} a thin plate of translucent bone & from it channels pass through the bone to the groove itself. These channels in the living bone contain veins which convey blood from the spaces of the petromastoid bone to the sigmoid sinus. This space like the others of the bone can be injected from the Eustachian canal, showing that the space communicates with the tympanic cavity & the injection medium can be seen emerging from the channels connecting this space with the sigmoid groove. I have specially drawn attention to this space because I believe that it is intimately connected with thrombosis of the sigmoid sinus, for the veins from this space open after a very short course into the sigmoid sinus. Again this space is much more closely connected with the sigmoid groove than the antrum proper which can be readily opened internal to the sigmoid groove.



Tegmen removed showing —
 1. Tympanum . 2. Antrum . 3. Accessory Antrum .



Section of Petro-mastoid showing —
 1. Membrana Tympani . 2. Tensor Tympani . 3. Ossicles
 4. Antrum . 5. Accessory Antrum .

Tegmen. We are now in a position to take up the consideration of the tegmen or roof of the tympanum. This is a thin plate of compact bone extending from the opening of the Eustachian canal to the junction ^{of the} upper border of the petrous with the squamous bone. Nominally it is said to form the roof of the tympanum, but the same thin plate of bone extends forwards over the canal for the tensor tympani, & backwards over the antrum & accessory antrum, each of which cavities may be opened by removing this thin plate. And what is of more importance the tegmen may be eroded by pathological processes in any one or more of these three regions. Internally the tegmen is limited by the inner boundary of the tympanum, antro-tympanal passage & the rearing up of the spongy bone behind the antrum. while externally it spreads outwards supported by open spongy tissue to the petro-squamous suture, through which the soft parts of the tympanum & its annexa become continuous



Section of Temporal Bone showing -

1. Inner end of External meatus. 2. Antrum with Tegmen above. 3. Spaces of mastoid.

*Portion of Bone removed
from above dissection
showing -*

3. Spaces of mastoid.

4. Accessory Antrum.

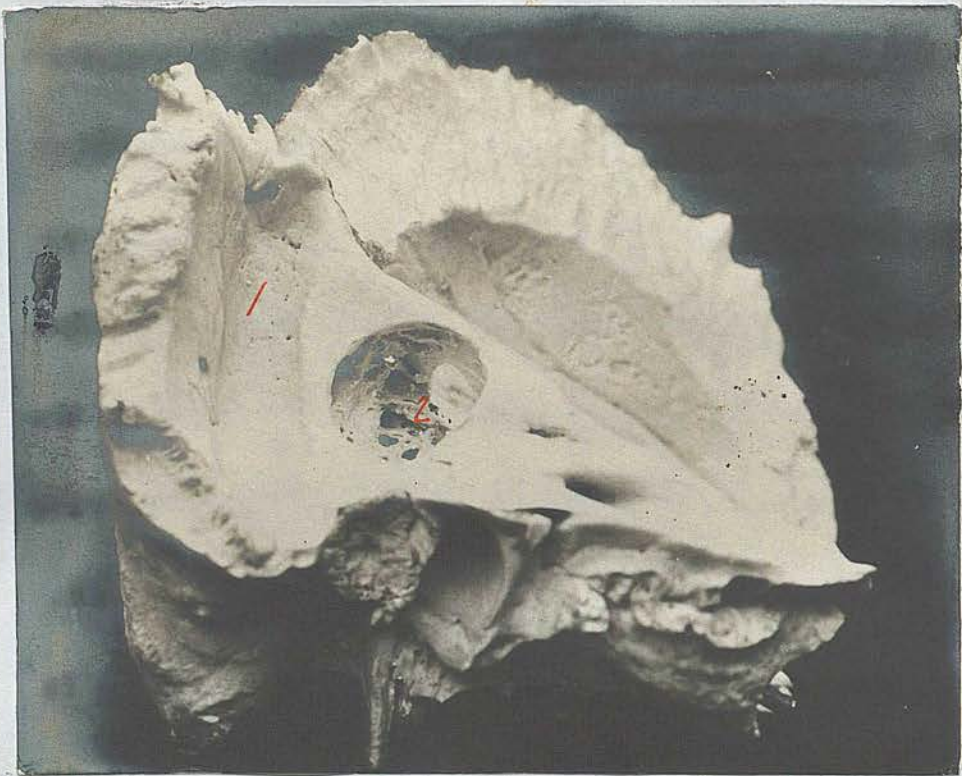


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with the dura mater.

I have dwelt at some length on the accessory antrum because I believe that it offers an explanation of the cause of thrombosis of the sigmoid sinus especially where the groove is not eroded & because it offers suggestions as to treatment. I first observed this space while demonstrating at the University of Edinburgh in 1890-1 & some of the dissections here were made at that time. I have made a large number of dissections of temporal bones & am convinced that it is always present though variable in size. It is difficult to imagine that this space can have escaped the notice of the many able workers in this field, but so far I have not seen any special note of it.

There are three principal complications occurring in connection with suppuration of the middle ear.

1. Paralysis of the facial nerve.



Posterior Surface of Petro-mastoid Showing —

1. Sigmoid Groove with numerous small foramina for veins
2. Antrum opened from behind, internal to Groove

2. Extension to the middle fossa of the skull.

3. Thrombosis of the sigmoid sinus & extension to the posterior fossa.

I am firmly persuaded that when thrombosis occurs in the sigmoid sinus it is by extension & infection from the accessory antrum the veins of which pass directly into the sinus. Moreover the plate of bone interposed between this space & the sinus is so thin as to form a very frail barrier to infective processes. And unless this space is cleared out at the same time that the antrum is under treatment there is risk that a focus of infection will still be left.

One point more & I have finished with the dry bone. The antrum is at a variable distance from the surface, from half to three quarters of an inch, the accessory antrum is posterior, external & superior to the antrum & about a quarter of an inch from the surface.

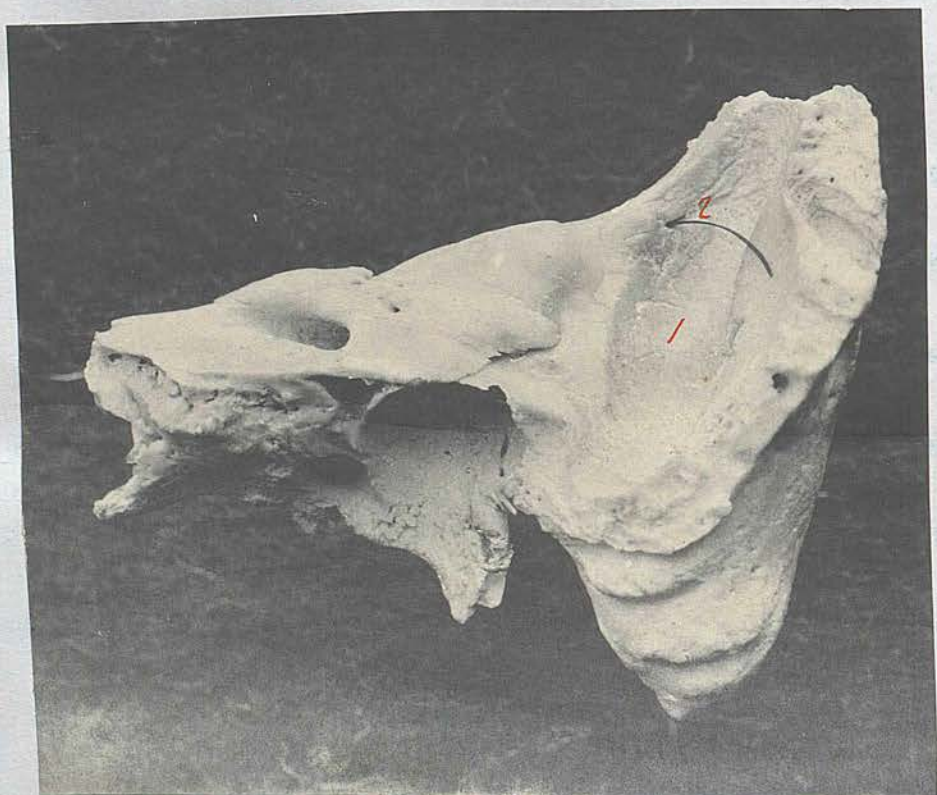
Vessels. The temporal bone is supplied by vessels from the carotid in the carotid canal, from the occipital through the stylo-mastoid foramen. A branch from the posterior division of the middle meningeal artery, the tympanic, through the petro-squamous suture & twigs from the ascending pharyngeal & tonsilic, ramify in the mucous membrane of the Eustachian canal & through it form a connection with the vessels of the tympanum. These vessels break up into branches which ramify over the tympanic cavity forming a complete network which extends to the antrum & the adjacent spaces of the temporal bone.

Sinuses. The venous blood is collected into sinuses large & small by means of which a free anastomosis is maintained & the blood conveyed out of the skull. These sinuses have gained greatly in importance in the light of recent years as the effects of thrombosis have become better understood.

The lateral sinus extends from the Torcular Herophili to the jugular fossa. It is of variable size & always larger on one side than on the other, usually the right. It is divisible into two parts, a horizontal part which now only is called the lateral sinus & a curved portion which is called the sigmoid sinus. It is with the sigmoid portion^{only} that we are concerned here. It presents at its upper extremity an anterior bend called the genu, placed behind the outer end of the superior border of the petrous bone. From this point the sinus curves downwards lodged in a deep groove on the inner surface of the mastoid, for an inch or more & then sweeps inwards, forwards & upwards to the jugular fossa, where it terminates in the lateral aspect of the bulbous upper extremity of the internal jugular vein, namely the jugular sinus. In the later part of its course the sigmoid sinus is directed upwards over the jugular process. This bony prominence has an important in-

Posterior Surface of Petro-mastoid showing -

1. Sigmoid Groove. *
2. Bristle in Foramen leading from Accessory Antrum.



fluence on the direction taken by the blood stream as it passes into the bulb & in preventing inspiratory efforts aspirating the blood from the cranium & thus suddenly diminishing the intra-cranial pressure. The sigmoid sinus is joined in front at the genu by the superior petrosal sinus & externally near the same spot by the mastoid vein, but with this difference that it receives blood from the superior petrosal sinus &, under normal conditions, gives blood to the mastoid vein. It is also joined by small veins from the petrous bone & by one larger than the rest on the anterior aspect of the genu, from the accessory antrum & adjacent spaces. The vein is important as I believe that further investigation will finally establish the fact that it is through it that thrombosis *in* the sigmoid sinus is started, in those cases where the groove is not eroded, & the sinus not directly invaded. The sigmoid sinus also forms a connection with the Torcular Herophili

Section of Petro-mastoid showing -

1. Facial nerve.
2. Auditory nerve passing to.
3. Cochlea.
4. Ossicles



& posterior condyloid vein, by a looped vessel passing between these points. It receives the subarcuate vein from the sphenoparietal sinus through subarcuate foramen.

The inferior petrosal sinus, though frequently spoken of as opening into the sigmoid does not do so, but joins the inner & anterior aspect of the jugular bulb & is of importance because by pouring its blood into the bulb it plays the chief part in restoring the lumen of the bulb, after collapse by the aspiratory effects of forced inspiration. The inferior petrosal sinus is connected with its fellow of the opposite side by the transverse sinus & receives veins from the cerebellum & internal ear.

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Veins from the temporal bone also open into the pterygoid plexus outside the skull.

Nerves. Into the internal auditory meatus pass the auditory & facial nerves, the former to pierce the cribriform lamina & end in the struct-

Section of Petro-mastoid showing -

- 1. The Antrum -*
- 2. The Promontory with bristle in canal for Jacobson's nerve.*
- 3. The Pyramid*
- 4. Aqueduct of Fallopius with Cord for nerve.*

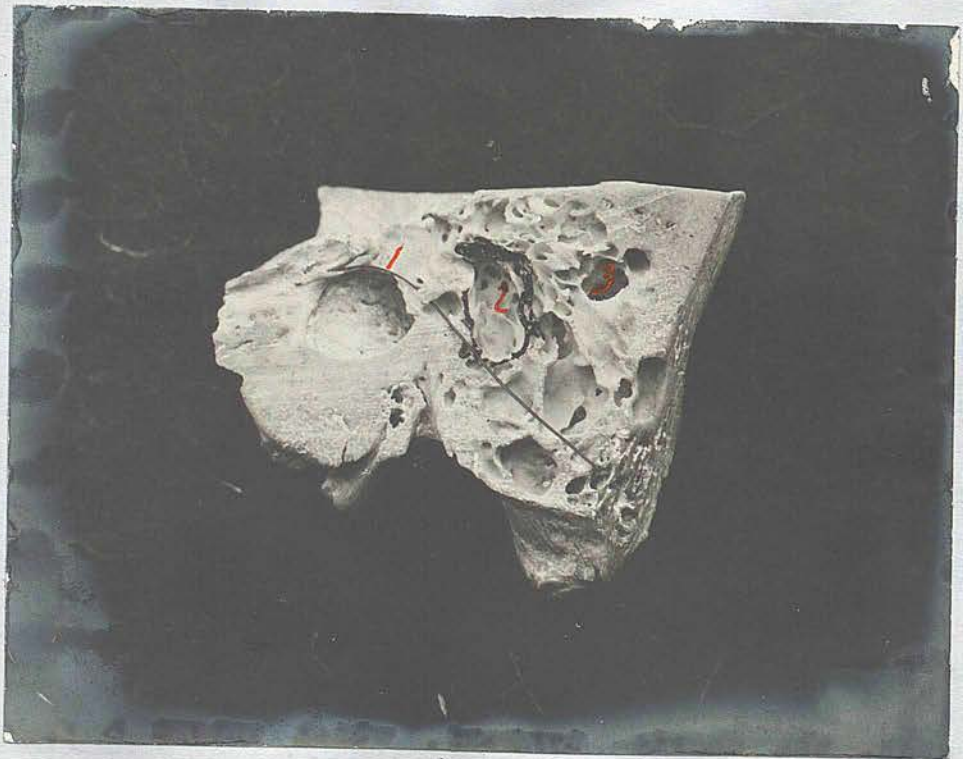


ures of the internal ear. The facial, the smaller, enters the aqueduct of Fallopius & at once enlarges to form the geniculate ganglion at the outer end of which the nerve bends suddenly backwards & taking a sweeping curve passes between the horizontal semi-circular canal above & the fenestra ovalis & pyramid below & then passes downwards to the stylo-mastoid foramen behind the inner wall of the tympanum.

In the first part of its course it lies to the inner side of the roof of the tympanum, having dense bone above & to the inner side, but below & to the outer side the bone is thin & translucent & frequently perforated in children. As the nerve passes between the semi-circular canal & the pyramid, it, with its osseous canal forms the inner boundary of the antro-tympanal passage & is specially liable to injury in operations on this region. In the remainder of its course the nerve is surrounded by dense bone. The fact that the

Section of Petro-mastoid showing -

- 1. Bristle for Chorda Tympani*
- 2. Antrum.*
- 3. Accessory Antrum.*



canal for the facial nerve is so thin in its lower & outer part, readily explains the frequency with which the nerve is involved in disease of the middle ear, especially in children, in whom the osseous wall is incomplete & closed by membrane & in whom simple pressure of pus may cause paralysis without actual involvement of the nervous structure.

Branches.. The great superficial petrosal nerve arises from the ganglion & passes directly forwards & inwards through the hiatus Fallopii to the foramen lacerum, below which it joins the great deep petrosal of the sympathetic to form the Vidian. From the same region a small filament is given off to join the small superficial petrosal of the tympanic plexus. At the base of the pyramid the facial gives off the branch to the stapedius muscle inside the pyramid. Near the stylo-mastoid foramen it gives off a considerable branch, the chorda- tympani, which enters a

1. Antium.
2. Promontory
3. Pyramid
4. Aqueduct of Fallopius



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special canal on the anterior aspect of the nerve & is directed upwards, outwards & forwards, & enters the tympanum near the upper end of the posterior wall at the outer side near the posterior margin of the tympanic membrane. From this point it passes directly forwards on the inner aspect of the membrane between the handle of the malleus & the long process of the incus & at a corresponding point in relation to the anterior margin of the membrane it enters the canal of Huguiier & passes thence out of this sphere of interest.

The tympanic branch of the glosso-pharyngeal nerve enters a small foramen in the ridge of bone between the jugular fossa & the carotid canal. From this point the nerve passes upwards & a little backwards & enters the tympanum through the forepart of the inner margin of the floor. It then runs upwards in a groove or canal on the surface of the promontory, being joined by twigs from the

sympathetic, from Arnold's nerve & from the facial
 It then enters a canal in the fore part of the inner wall & being joined by a twig from the facial passes on to the cerebral surface of the bone on its way to the foramen lacerum. The branches of nerve on the promontory are known as the tympanic plexus & from it branches are directed forwards to the opening of the Eustachian canal, to the two fenestræ & backwards to the spaces of the bone.

Membranes. The tympanic cavity, antrum & spaces of the petromastoid are lined with mucoperiosteum containing many mucous glands & continuous with the mucous membrane of the Eustachian canal. It is prolonged over the ossicles, ligaments tendons & nerves in the cavity & carries the vessels from which these structures derive the major^{part} of their pabulum.

The dura mater closely invests the entire cerebral surface of the bone being intimately applied but not firmly adherent to it. At the var-

ious foramina, depressions & fissures the deep tissues of the dura are prolonged into the adjacent spaces & gives a covering to the nerves. To this aspect of the bone the membrane is a sero-periosteum, carrying arteries, veins & sinuses by means of which blood is conveyed to & from the bone. From the region of the tegmen, the dura is easily stripped owing to its feeble attachment.

Brain. The temporo-sphenoidal lobe of the brain is in close contact with the superior aspect of this part of the bone, being separated from it only by the membranes & owing to the slope of the plane of this surface of the bone, the water-bed in this region is very thin so that inflammatory processes extending from the tympanum readily weld the membranes together & to the cerebral substance. In such cases pathological processes extend from the tympanum to the cerebral substance by direct continuity of tissue. The cerebellum is in contact by its anterior & lateral as-

pect with the posterior surface of the bone & with the sigmoid sinus which in cases of thrombosis may groove the cerebellum & frequently stain it of a dark colour. Inflammatory processes here also from the region of the sinus may glue the membranes together & to the cerebellum, but the cerebellum is less liable to become fixed than the cerebrum.

Muscles. The tensor tympani arises from the sides of the canal in which it lies & its tendon passing out at the apex of the canal is directed over a pulley to be inserted into the base of the handle of the malleus. It is supplied by a branch of the fifth nerve. The stapedius arises from the inner surface of the pyramid & is inserted into the top of the stapes. It is supplied by the facial nerve.

P A T H O L O G Y.

Having thus briefly referred to a few points in the anatomy of the temporal bone, we pass to the consideration of the pathology of suppuration in this bone & its effects on adjacent structures; effects which are far reaching in their influence & produce a train of symptoms, which rightly interpreted may lead to recovery, but if missed will in many cases lead to disaster.

Ætiology. The cause of suppuration in the middle ear is primarily organismal, but the immediate cause may be briefly said to be:- fevers diphtheria, tonsillitis, septic sore throat, adenoids nasal suppuration, foreign bodies, retro-pharyngeal abscess, tubercule. From whatever cause arising acute suppuration in the tympanum is not of very serious import, as after evacuation of the pus, whether by natural or artificial means, the parts may be practically restored to normal. But as the suppuration is not speedily terminated a series of

important changes develop in the tympanum to the consideration of which we may usefully devote a little time. Amongst the first effects of suppuration in this region is the more or less complete destruction of the muco-periosteum as such. According to the intensity of the process two distinct results may follow & both may be in progress at different points in the same case or follow upon each other. I refer to caries or rarefying osteitis & osteo-sclerosis.

Caries. When suppuration occurs in the tympanum, except in very mild cases, the antrum is invariably involved in the process. It has already been said that the opening of the Eustachian canal is in the upper part of the anterior wall of the tympanic cavity, & as a consequence the cavity cannot drain itself completely, unless as rarely happens, the membrane is perforated at its lower margin. The antro-tympnaal passage has a like relation to the anterior wall of the antrum, & a

like result follows in defective drainage. As a consequence we have the two cavities always containing a residuum of pus. The lining membrane is swollen & presently becomes replaced by granulation tissue. In the tympanum the granulation tissue strangles the blood vessels upon which the ossicles depend for their nutrition, the ligaments become softened & the ossicles eroded & may be necrosed. The attic, likewise, becomes filled with granulation tissue & eroded & the wall of the Fallopian aqueduct may suffer a like fate & the granulation tissue extend into the canal & invade the nerve. As the granulations increase they pout through the opening in the membrane & may attain such a size as to present at the orifice of the external auditory meatus. While this is proceeding in the tympanum, important changes are taking place in the antrum. As already ^{stated} the antrum is surrounded by spongy tissue & into the mesh-work the pus & granulations extend, the muco-periosteum is destroyed

& the osseous trabeculae are gradually eroded & disappear, the space becoming enlarged. It is a remarkable fact & fortunate circumstance that during this process the absorption takes place in an outward direction so that the caries does not extend through the posterior surface of the petrous bone, but through the descending plate of the squamous portion, forming a subperiosteal abscess. In the same way, the caries progressing leads to disintegration of the osseous septa of the mastoid & from ^{region} to erosion of the sigmoid groove, laying bare the sigmoid sinus & producing granulation tissue & pus between the dura & the bone. In some cases the antrum is found to have been greatly enlarged & the spaces of the mastoid more or less completely coalesced. In the mastoid region this may produce effects in an unexpected direction. In some mastoids the bone consists of a simple shell or case of bone, the interior of which is simply honeycombed by large spaces with thin septa. In

such cases the bone in the region of the digastric fossa is very thin & porous at the site of the origin of that muscle & the process of erosion may involve this part of the bone which may become perforated & the pus & granulations then have free access to the deep regions of the upper part of the neck behind the deep fascia. In such cases a new train of symptoms are developed, for the elucidation of which Bezold has directed attention to an important sign sometimes known by his name.

Effects upon the Tegmen. The carious process which has been described is by no means confined to the floor & lateral walls of the spaces in which it occurs. The roof also participates in the process of disintegration & here the effects are of even greater importance. Attention has already been directed to that thin plate of bone forming the tegmen. This may become perforated by a number of small apertures so as to become

cribriform or it may be eroded forming one or more relatively large apertures. Through these apertures the pus & granulations extend to the space between the dura & the bone.

Effects on the Dura Mater & other membranes of the Brain.

When the pus & granulations have come in to contact with the membranes of the brain the effects are strikingly different. From the point of contact of the granulation with the dura, there commences a mild inflammation of the dura affecting all its layers. The membrane becomes swollen, the vessels injected & on the cerebral surface the epithelium begins to proliferate & a layer of lymph is thrown out, which spreads to the arachnoid this also becoming involved in the inflammatory change. Later, the pia & brain substance become adherent to the arachnoid & dura. The inflammation is most intense at the point of contact with the granulations & from that point

gradually fades towards the periphery. The involvement of the pia necessarily produces some extension to the adjacent cerebral substance, so that we have meningitis involving not merely the dura, but also the arachnoid & pia & some inflammation of the brain substance. As the process goes on the dura at the point first involved, becomes softened & finally perforated, pus having previously formed in its substance & on its cerebral aspect. In this way a subdural abscess is formed which may and indeed usually does leak through the causal granulations & by them, through the tegmen. An abscess of this kind is bounded laterally by membranes soldered together by lymph, & on its cerebral aspect by brain substance in a state of ulceration with tags of pia mater.

It will readily be understood that any vein which lies in the track of such a process as that just described will become involved in the inflammation & as a result thrombosed, with extension

of the thrombus into the cerebral substance & subsequent softening & abscess formation, the abscess being more or less shut off from the exciting cause & surrounded by a zone of inflamed cerebral tissue.

Let us turn to the effects of this process on the sigmoid groove. As already stated the walls of the groove may be eroded & the wall of the sigmoid sinus undergo similar changes to those described in connection with the dura in the middle fossa, but with this great difference, that the inner surface of the sigmoid sinus when inflamed produces thrombosis at a point & spreads therefrom upwards, downwards & circumferentially & ultimately leads to complete occlusion of its lumen. The thrombus softens & the pus may escape from the sinus in to the mastoid or be carried into the general circulation*. The inflammation, extending through the cerebellar wall of the sinus, sets up meningitis, which mats the membranes together &

produces subdural abscess with ulcer or abscess of the cerebellum. In some cases, the thrombus extends downwards producing phlebitis & thrombosis in the internal jugular vein. Another small sinus forming a connection between the sigmoid & the condyloid veins may be involved in the process & by this means the thrombosis may extend to veins outside the skull, in the upper part of the posterior triangle of the neck.

It is well known to those who have operated on many cases of mastoid disease, that instances occur in which the sigmoid sinus is thrombosed without erosion of the sigmoid groove. How are these cases to be explained? The infection must have taken place through some other channel. As previously stated, the vessels of the accessory antrum communicate directly by at least one vein with the sigmoid sinus, & it is by this means that the infection spreads to the sinus; therefore it is of importance in operating on such cases

that the accessory antrum should be subjected to to the same treatment as the antrum proper, otherwise a focus of infection will be left.

The results which have been detailed in the preceeding remarks are only compatable with mild & long continued inflammation, during which conservative changes take place, resulting in the aglutination of the serous layers. When, however, the process is more rapid a different series of changes develop. If the disintegration of the dura takes place before the plastic inflammation has had time to cut off the diseased area, then the infective material passes at once into the subdural space & the cerebro-spinal fluid becomes infected & as this fluid forms a continuous layer surrounding the brain & spinal cord, communicating with that in the cavities of these organs, the poison is rapidly disseminated, setting up cerebro-spinal meningitis.

The cerebro-spinal fluid first becomes turbid & later purulent; the membranes injected &

coated with flakey lymph. Such a condition is incompatible with life & the patient frequently dies before this stage is reached.

The sclerotic form of the disease is not as interesting as the carious variety & does not present such striking results. In this form the bone surrounding the antrum & the larger foci of granulations becomes dense, ivory-like & of almost stony hardness, the spaces of the mastoid being almost entirely obliterated. The inflammatory action in such cases is mild & of a very chronic form & the osteogenetic layer of the muco-periosteum lining the spaces still retains its function as do also the bone cells in the lacunæ. It is remarkable, however, how feeble the blood supply appears in the later stages of the disease when the parts are under operation.

The disease is not always so uniform as that described. It is liable to interruption at any period of its course, & at any period & at

any point, the one variety may give place to the other & again revert to the former type.

The chorda-tympani nerve suffers early in the disease. It is invaded & its tissue destroyed producing loss of taste in the anterior two-thirds of the tongue on the affected side.

The facial nerve may be affected early in the disease causing paralysis, which may be due simply to pressure & be readily recovered from. Later in the disease the nerve may be actually invaded & destroyed, causing permanent paralysis & consequent loss of expression on that side of the face, defective salivation, & if occurring early in life imperfect development of that side of the face. The auditory only becomes involved in those comparatively few cases, where the suppuration extends through either or both fenestræ.

The inflammatory ^{process} spreads by direct continuity & hence we find that the cerebral membranes may become involved by extension through

the petro-squamous suture & along any of the various channels connecting the tympanum & mastoid cells with the cranial cavity. The disease may pass along the aqueduct of Fallopius or through the internal ear & the internal auditory meatus. Erosion of the inner wall of the tympanum, below the promontory, may lead to communication with the jugular fossa & the deep structures of the neck. The carotid canal may also be opened by erosion of the forepart of the inner wall of the tympanum & extension readily takes place along the various small veins communicating with the tympanum.

So far we have assumed that the membrana tympani is perforated; but though this is usually the case it is by no means always so. There may be chronic suppuration in the middle ear with extensive erosion of bone & even involvement of the intra-cranial tissues without perforation of the membrane, the pus being discharged by the Eustach-

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ian tube. It is therefore advisable in all cases presenting obscure head symptoms, where the membrane is not perforated, to examine the orifice of the Eustachian tube.

The following are some of the organisms which have been found in cases on which I have operated.

Streptococcus pyogenes aureus.

Streptococcus pyogenes albus.

Staphalococcus pyogenes.

Bacillus fœtidus.

Bacillus pyocyaneus.

S Y M P T O M S.

The symptoms produced by chronic suppuration in the middle ear may be practically nil, for except a small or moderate amount of purulent discharge there may be nothing to cause the patient any discomfort or inconvenience, save the unpleasant odour from this fœtid discharge. An otorrhœa of this kind may go on for years but it is always a source of danger to its possessor; a magazine which may at any moment explode with serious consequences. In some instances the discharge may be so profuse as to run down the cheek, & in many cases grave symptoms develop causing the patient to seek advice. These grave symptoms arise from a variety of causes, cold, some fresh inoculation, & unfortunately sometimes from treatment. As a rule the granulations put through a perforation in the membrane & may grow to so great an extent as to present at the orifice of the meatus. Unfortunately they have come to be

known as aural polypi, & it is customary to look upon the removal of these polypi as a trifling procedure & devoid of all danger. Experience does not bear this out. Let us look for one moment at the condition. A mass of granulation tissue is generally admitted to be a "casting off surface" & as such is not likely to take up infection; but if a so called polypus is removed wholly or partially, the stump consists of lacerated vessels & open lymph spaces into which infective material can readily pass setting up acute inflammation. But there is yet another possibility which must not be lost sight of. The polypi usually fill up the meatus so that it is not possible to see the condition of the membrane & of necessity it is not possible to form any idea of the condition of the tympanic cavity itself. The granulations are continuous with those in the tympanic cavity & they may, for ought we know, protrude through the tegmen into the dura. Traction then may extend

from the meatus to the tegmen, causing laceration of the vessels there & fresh infection with extension of inflammation.

These remarks also apply to the dropping into the ear of astringents such as alcohol. Again an accident may be the exciting cause, a sudden blow or fall may lacerate these granulations. In many cases the cause of acute symptoms is so obscure as not to be definitely ascertainable. In some cases the onset of acute symptoms may be due to defective drainage. The discharge may become dammed back in the meatus by drying up with consequent increase of tension in the tympanum & adjacent spaces. It is a notorious fact, that the onset of acute symptoms is frequently accompanied by cessation of the discharge, whether as cause or result it is not easy to say. In this there is a striking resemblance to those cases of puerperal fever where the feverishness & suppression of lochia are coincident. Other examples might be cited if

need be.

Under these circumstances, it will be seen that the disease resolves itself into two types:-

1. Those in which there are no actively acute symptoms, & which come under observation on account of some inconvenience, such as profuse of foul discharge.

2. Those in which acute symptoms are present.

The symptoms may be divided into local & general.

Local. The local symptoms are pain in the ear & side of the head, pain & tenderness over the mastoid especially on percussion, pain in the upper part of the posterior triangle of the neck, & pain along the internal jugular vein. Pain as a symptom in ear disease is a very important one. Rapid extension of suppurative ear disease is always associated with pain in the ear & side of the head. It varies in amount from that producing discomfort, to that producing intense agony, causing

the patient to shriek & toss about. If there is free exit for the pus the pain is less severe. In some cases the pain is referred to the vertex, occiput or forehead; but this is more common in meningeal or cerebral complications. In some cases of lepto-meningitis the patient suffers pain in various parts of the body owing to the inflammatory action on the roots of the spinal nerves.

Tenderness is usually to be elicited on percussion over the mastoid & in some cases over the squamous temporal & when the sigmoid is implicated there is usually tenderness on pressure over the upper part of the internal jugular vein of the same side & may be over the upper part of the posterior triangle of the neck.

Oedema first & later redness over the mastoid, also occurs in acute or subacute extension to that region & subsequently, may be followed by a subperiosteal abscess with all the local signs of that condition; together with the peculiar dis-

placement of the pinna of the ear, which is well illustrated by the accompanying photographs.

General Symptoms. As regards the general symptoms, they vary in amount & character with the nature & extent of the spread of the disease. It is a remarkable fact, that a patient may suffer ^{from} a fatal extension of middle ear disease, whose localizing symptoms may be so unobtrusive as to readily escape detection. This must be constantly borne in mind. Roughly speaking, one may say that the general symptoms comprise alteration in temperature, pulse, respiration, motor & sensory functions, both common & special sense. Derangement of the stomach & bowels. Optic neuritis is a sign that should always be looked for in cases of extension of middle ear disease.

As the mere enumeration of symptoms conveys little idea & leaves less impression I propose to detail a few cases which have come under my own observation illustrating different forms

of the disease as they come under treatment & which also serve as indications for operation. These cases are taken from a series of sixty seven on which I have operated with two deaths & facial paralysis in two.

CASE 1. Chronic otitis media with profuse foetid otorrhoea. Several years duration. Operation. Recovery.

The patient, a boy of 17 years, had suffered from chronic otorrhoea since he had scarlet fever eight years ago. During the last two years the discharge had become much more profuse so that now it amounted to a constant flow & if left for some time would emerge from the meatus & run down the cheek or neck. His pocket handkerchief was much stained with pus as he had used it to wipe away the discharge. There was a tuft of granulations filling up the inner half of the meatus. The pus was foetid. There was no tenderness



over the mastoid. Antiseptic syringing & the use of chromic acid had been tried without success. As the condition was one of great discomfort to the patient & annoyance to the household, the evil odour permeating the whole dwelling; it was decided to operate. The antrum & tympanum were cleared of the granulations with which they were filled, No ossicles were found. A drainage tube was passed through the wound & enlarged antro-tympanal passage & out of the meatus. The parts were dressed at first daily & later at longer intervals & the tube removed at the end of a month.

This case was seen two years after the operation & found quite well. The depression over the mastoid had to a great extent filled up & the inner end of the meatus was closed by firm cicatricial tissue covered with epithelium. There was no discharge & had been none "for a long time", & the cicatrix at the inner end of the meatus was concave & glistening like a drum. The hearing

was defective on that side as shown by the watch, but his bone conduction was good & for ordinary conversation his hearing appeared normal.

CASE 2. Chronic double otitis media, otorrhœa slight but extremely fœtid, constant headache, lassitude, left facial paralysis & marked impairment of hearing. Operation. Marked improvement.

Mrs. D. æt. 35years. Had been a strong, active, healthy woman & had six children. She had suffered from gathered ears for many years, cause unknown. Her face had been twisted for about two years. The discharge was small in amount but extremely foul. In fact when the door of her house was opened, the odour met one like a dense bank of fog & the patient & everything about her seemed to possess the same foul forbidding odour. Her hearing was markedly impaired, & she had complete left facial paralysis. Both meati were choked with thick, cheesy, foul pus. She was unable to take

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any active part in her household affairs or in her personal appearance; complained of constant headache over the vertex & occiput, & an utter inability to do work.

It was felt that the headache, lassitude, loss of appetite & general torpor were due to infection of the whole system by absorption from the decomposing matter in the antra & mastoids. There was no pain or tenderness in the mastoids. Double antrectomy was performed at two separate operations & the antra & tympana cleared out. Nothing was seen of the ossicles & the parts were treated as in case one.

Subsequently the patient became brighter, the fœtor disappeared & she began to take interest in her surroundings. Her skin which had been of a dull murky colour also improved & when last seen she was much more active, & her hearing, though still bad, was less so than before the operation. Some hopes were raised, soon after the

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operation of recovery of the facial paralysis by the occurrence of tremulous movements in the eyelids, but the improvement did not proceed beyond this stage.

This case is of interest as being a striking example of the sclerotic form of the disease. As already stated it was expected that the spaces of the mastoid would be found full of pus, but during the operation no such spaces were found. The mastoid consisted of one solid mass of dense, ivory hard bone, & when the antrum was reached it was found to be surrounded with dense hard bone not the spongy bone so often found.

CASE 3. Chronic otitis media with eczema of meatus & pinna. Acute symptoms while under treatment for eczema, right facial paralysis. Operation. Recovery.

E.J. æt 15. a school boy. Family history good. He had suffered from otorrhœa from an attack



Case showing Sub-Thoracic Abscess -

of scarlet fever in childhood. It had varied in amount sometimes disappearing for a time & then coming on again. Sometimes he had pain in the ear & side of the head, which was relieved by the return of the discharge. For the last three months he had suffered from eczema of the meatus & adjacent part of the pinna. A fortnight before seeing him he began to suffer pain in the ear & side of the head & to be feverish & ill. The discharge from the ear ceased & the pain & distress increased & at times became so severe that he shrieked. About three days before he came under observation it was noticed that "his face was to one side". His temperature was 102F. with accelerated pulse & respiration, furred tongue & constipation. There was pronounced right facial paralysis redness & cedema of the mastoid, & scaly eczema of the pinna & the meatus contained some inspissated pus.

An operation was undertaken the next day.

The mastoid, antrum & tympanum were cleared out



Case of Sub-periosteal Abscess -

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& the malleus was discovered eroded. The pus was not foul. The after treatment was as in the previous cases with the addition that the Faradiz current was applied daily to the muscles of the face. The patient made a perfect recovery.

CASE 4. Chronic otitis media, acute symptoms, subperiosteal abscess. Operation. Recovery.

J.J. æt 15. a tinworker. Had always been a healthy lad although he had had otorrhœa for years cause unknown. About three weeks before he came under observation he began with pain in the ear & side of the head, he was feverish & at night the pain was so great that he could not sleep. This state of things continued for a fortnight, when a swelling formed behind the ear which gradually increased in size. After the formation of the swelling, the pain abated somewhat & the discharge from the ear, which had been absent, reappeared. When first seen there was a marked deformity in



Case IV. Subperiosteal Abscess -

the side of the head. The right side of the head was much more rounded & full than the left, the right ear was displaced outwards, forwards & downwards & this was even more apparent when seen from behind. On examination, the swelling was found to be fluctuating & the skin tender, red, & œdematous. The pinna behind showed the debris of the popular treatment by linseed. From the meatus there issued a sluggish stream of fœtid pus, which entirely filled the passage. There was marked impairment of hearing on the affected side. At the operation a perforation was found in the descending plate of the squamous, through which the pus had found its way from the antrum to the surface of the bone. The antrum, mastoid cells & tympanum were cleared out, & the wound subsequently allowed to heal. The boy made a good recovery.

It is only in those cases of caries that the pus is able to find its way to the surface, through such a thick layer of bone as intervenes between

the antrum & the surface. In cases where this portion of the bone is sclerosed, perforation must take place through some lesser barrier as into the sigmoid groove or through the tegmen.

CASE 5. Chronic otitis media, acute symptoms, subperiosteal abscess, thrombosis of sigmoid sinus, lepto-meningitis. Operation. Death. Post mortem.

J.T. æt 10. school boy. Had had a discharge from the ear (right) for years, dating it was thought from one of the exanthemata, but "nothing to harm" as the parents explained. He had always been a sharp boy & healthy. About three weeks before he came under observation, after bathing in the canal, he complained of pain in the right ear, which rapidly became worse & extended over the side of the head. He was hot & feverish & refused food & of course was confined to bed. After this condition had lasted about ten days, a swelling formed behind the ear, which was incised giving

vent to about an ounce of pus. A drainage tube was inserted through the wound under the skin & from the wound there continued to ooze some foetid watery pus. At first he seemed to be relieved his temperature fell a little & the pain abated. But the improvement was short lived, the pain & fever returned & when I saw him, his condition was much as follows:- He was flushed & from his breath & everything about him there rose a horribly putrid odour. His temperature was 103F. & the pulse & breathing rapid. He was unconscious, restless throwing his arms about & intolerant of any restraint. Every now & again he would shriek with pain & call for a drop of canal water. There was pain in the neck & any attempt to alter the position of the head brought on a return of the restlessness & shrieking. The line of the internal jugular vein & upper part of the posterior triangle of the neck were extremely tender. Behind the ear

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was a linear wound about half an inch in length with a small drainage tube in it. The skin around was soddened with pus & the edges of the wound were dark & sloughy & from the meatus there issued a small quantity of foetid pus. The case was looked upon as one of acute extension to the mastoid with sigmoid sinus thrombosis & probably meningitis.

The mastoid antrum & tympanum were cleared. An erosion of the sigmoid groove was enlarged the sigmoid sinus was opened & the clot removed as far up & down as could be reached, but no blood came into the sinus, showing that the limits of the thrombus had not been reached. There was practically no improvement after the operation & the boy died next day.

Post Mortem. It was found that the sigmoid sinus was thrombosed in its entire length & on its cerebellar aspect was stained almost black. The membranes were injected & the surface of the

cerebellum in contact with the sinus was also stained. There was no pus in the cranial cavity. Death I take it was due to septicæmia.

CASE 6. Acute otitis media probably superadded to chronic, no perforation of the membrana tympani, subdural abscess, optic neuritis. Operation. Recovery.

J.J. æt 40. a sawyer. Had always been healthy & never at any time had any discharge or moisture from his ears..

When he came into my consulting room he brought with him that foul odour of putrid pus, which seems always to herald the approach of a bad ear case. He was profoundly ill, temperature 103F. intense pain on the top of the head with foul tongue & breath & a condition of delayed cerebration, there was no perforation of either drum; but the left membrane was congested & he had ten-

derness over the mastoid (left), but otherwise the symptoms except for optic neuritis were negative. I concluded that there was suppuration in the middle ear & antrum, with probably pus in connection with the dura. The mastoid was opened & the tympanum & antrum cleared. After this, pus was found coming from the tegmen which was opened & about half an ounce of pus came away, apparently from within the dura which was perforated. During the manipulation unfortunately the facial nerve was damaged but it recovered to a great extent under treatment. This patient had optic neuritis, which lends support to the subdural position of the abscess. It was interesting to observe the improved mental condition after evacuation of the pus. His answers came with readiness, his skin cleared, putridity disappeared & he made an excellent recovery.

CASE 7. Chronic otitis media, extra-dural abscess

Operation. Death. No post mortem.

A.B. æt 23. engineer. Family History good.

He had been a delicate boy when young & had had harelip & cleft palate, the former of which had been remedied by operation. He had had a discharge from the left ear from childhood & had, on various occasions, attacks of pain in the head during which the discharge had been absent; but which was always relieved when the discharge reappeared.

About three days before he came under observation he began to feel unwell, could not take his food, became dull & apathetic & gave up his usual occupations & pastimes & when questioned he said he had headache & again lapsed into silence. When first seen he was in bed, lying flat upon his back, breathing slowly with steady pulse 80. His eyes were closed & he took no notice of those around him, temperature 102F. tongue coated, & there was about him & his breath a suspicious

odour.

Examination of the ear showed at the inner end of the meatus some inspissated pus of the usual foetid character. The membrane could not be seen, there was no tenderness along the line of the internal jugular & percussion of the mastoid & squamous regions gave negative results. Mentally his condition was one of stupor, he could be roused when spoken to; but he answered in monosyllable & again lapsed into silence. The first thought was that it might be a case of extension to the mastoid, but there were no symptoms, no tenderness on percussion over the mastoid & the case was left till the third day. As there was no improvement & as nothing else could be found to account for the condition, it was decided to operate. This was accordingly done & extensive suppuration was found the pus extending into the sigmoid groove & far into the cerebellar fossa passing down to the jugular foramen. The sigmoid

sinus was not thrombosed & the bone was stained
a dirty brown colour. The pus was very foetid &
green the patient was not relieved & died the
next day & unfortunately no post mortem was al-
lowed.

T R E A T M E N T.

Palliative treatment consists of cleansing the parts by syringing with antiseptic lotion & the use of chromic acid, or some such substance, to curb the granulations. In some cases this treatment seems to effect a cure, but in others the results are less happy. In those cases in which the antrum & tympanum are filled with cholesteat-
omous masses any lotion which may be used is un-
able to reach the antrum, & even if reached, the greasy nature of its contents leaves it un-
affected by the antiseptic used hence little bene-
fit is derived from this form of treatment.

I should like in this place to raise one word of protest against the insufflation of powdered medicaments into the meatus, which tend to cake & prevent the free outlet of the discharge.

Radical. I think that the cases which have been briefly described sufficiently illustrate

the various indications for the operation.

The operation has for its object the opening of the mastoid antrum & spaces, & the thorough cleansing of these, together with the tympanum, & the final obliteration of the antrum & spaces by new formed tissues, fibrous or osseous as the case may be. To this must be added the evacuation of abscess in the brain or cerebellum or in relation to the dura, & ablation of the sigmoid sinus in case of thrombosis.

The parts are prepared in the usual way by shaving, liberal washing & the use of antiseptic compresses.

The incision through the soft parts may be straight or curved, & of such length as may suit the taste of the operator, extending always from the tip of the mastoid & close to & parallel with the anterior border. It should always be carried down to the bone at once & the soft parts with the periosteum in front & behind raised from the

bone. The opening in the bone may be made with gouge & mallet, the gouge worked by hand alone, by Macewen's ^{burrr}s/. The entrance into the antrum is to be made through the base of Macewen's supra-meatal triangle. But it is well to remove the bone wide of this so as to give more room. Having reached the antrum, one has to remember that above is the tegmen with the temporo-sphenoidal lobe, behind & external is the sigmoid groove & in front the facial nerve. In front also is the antro-tympanal passage, all of which are liable to injury.

As regards the after treatment many different methods are in vogue, all having for their object the healing of the cavity from the bottom, which is necessarily a slow process.

The results of the operation ^{are beneficial} both locally & generally; the patient being saved from almost certain death. The dangers of the operation, where there is ~~not~~ involvement of the intra-cranial

structures, are almost nil as regards the life of the patient, as regards disfigurement non-existent, as regards the function of the organ there is always some impairment of hearing & may be deafness. In some cases the hearing is somewhat improved after the operation.

In those cases where the infective process extends to the membranes, without limiting adhesions having formed, the result is usually fatal whether operated on or not; when limiting adhesions form the results of operative treatment are immensely superior.

Opinion is divided as to what cases should be subjected to the radical operation. Leaving out of account those cases where acute symptoms have developed indicating extension to the mastoid about which there can be no difference of opinion, there is still a large class where the operation if performed, must be considered as one of expediency rather than of necessity.

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It is argued on the one hand, that inas-
much as every case of chronic suppurative otitis
media is a magazine which may explode at any
moment with serious consequences to its possessor,
all cases should be operated on; while on the
other hand, some authorities hold that such a pro-
ceeding is unjustifiable, & lay down certain defin-
ite indications without which the operation should
not be undertaken.

In favour of the first view it must be
added that there is great risk of acute symptoms
supervening at any time, that the class of case
in which they will supervene cannot be recognized
before the onset. Standing in presence of a case
of chronic suppurative otitis media it is impos-
sible to say whether this is one ⁱⁿ which extension
to the mastoid is likely to occur. And again,
that the risks of the operation are extremely
small the danger to life is practically nil, &
& the risk of disfigurement by the scar non-exist-
ant,

& of facial paralysis is very trifling, & finally after the operation the patient is placed in a condition of safety. As regards the defect in the function of hearing I believe, that that is due to the disease rather than to the operation.

On the other hand those against the universal operation hold, & rightly, too, that although every case may be a magazine it does not always explode, & as a matter of fact, it explodes in only a small percentage of the total cases.

One is naturally led to ask why some cases should go on suppurating for a great number of years, & never develop complications, while others do, & why the incidence of acute symptoms should bear no relation to the duration of the disease, or amount of the discharge. At the Deaf & Dumb Institution here where a considerable number of the inmates are deaf after scarlet fever, & have a purulent discharge from one or both ears, I have in eight years seen only one case of mastoid

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complication & that one after proceeding to swelling, œdema & tenderness over the mastoid entirely subsided under simple treatment, no operation being permitted.

I think the explanation is two-fold:-

First it depends upon the anatomical arrangement of the interior of the temporal bone. One is naturally inclined to think that one temporal bone is the same as another, but this is by no means the case. I believe that there is no bone in the human body subject to so much variation as regards the cells & spaces. In some bones the air spaces are large, the septa thin, & the intercommunications between the spaces free, while in others the spaces are small, the septa thick & the intercommunications feeble. In some bones the accessory antrum is small, in some it is so large as to communicate with the diploëic space.

Second it depends upon the nature of the pathological process. In the carious variety the

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spaces are enlarged by absorption of the septa, & even small spaces with thick septa may be rapidly enlarged, leading to early extension. In the sclerotic form the thin septa tend to be thickened & the spaces diminished & the purulent material shut off & extension in this way prevented.

It must be obvious to every one that as it is impossible to ascertain the nature of the anatomical arrangement, & the nature of the pathological change going on, it is impossible to dogmatize as to which case is liable to extension & which not.

To the many indications which have been laid down as justifying the operation, I think one may be added, & that is the possibility of obtaining surgical relief readily in case of the sudden appearance of acute symptoms. For instance a case of chronic suppurative otitis media is going on a long voyage, or as a case under my own observation, going to Canada connected with mining operations

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in an out of the way district. In such cases it is impossible to obtain skilled surgical treatment within reasonable time in case of acute symptoms supervening & the patient might succumb. Therefore if the patient's surroundings are such that skilled surgical treatment cannot be obtained within a few hours it is better to operate than leave him to run the risk.

In conclusion I may say that the dissections & photographic illustrations have all been done by myself & the dissections will be at the disposal of the Examiners at the Anatomical Department during the Clinical examination if they consider it worth while to look at them.

Swansea Expt 1901.